CLAIMS

1. A power system to provide power between a DC device and at least one of a primary alternating current AC device and a secondary alternating current AC device, the power system comprising:

a bi-directional power converter comprising a set of alternating current AC terminals, a set of DC terminals, and a number of bridge legs electrically couplable between the set of AC terminals and the set of DC terminals, at least some of the bridge legs selectively operable to invert a current when the current is flowing from the set of DC terminals to the set of AC terminals and to rectify the current when the current is flowing from the set of AC terminals to the set of DC terminals; and

a first switch operable to selectively electrically couple and uncouple the secondary AC device respectively to and from the set of AC terminals of the bi-directional power converter.

2. The power system of claim 1, further comprising:

a second switch operable to selectively electrically reverse a polarity of a coupling of the DC device to the set of DC terminals.

3. The power system of claim 1, further comprising:

a capacitor;

an inductor;

a diode, wherein the capacitor, the inductor and the diode are electrically coupled with at least one switch of at least one of the bridge legs to form a boosting circuit; and

a second switch operable to selectively electrically couple and uncouple the boosting circuit between the set of DC terminals of the bi-directional power converter and the DC device.

4. The power system of claim 1 wherein the first switch is further operable to uncouple the primary AC device from the set of AC terminals of the bi-directional power converter when the secondary AC device is coupled to the set of AC terminals of the bi-directional power converter and to couple the AC primary device to the set of AC terminals of the bi-directional power converter when the secondary AC device is uncoupled from the set of AC terminals of the bi-directional power converter.

5. The power system of claim 1 wherein the first switch is a multi-positional switch operable to uncouple the primary AC device from the set of AC terminals of the bi-directional power converter when the secondary AC device is coupled to the set of AC terminals of the bi-directional power converter and to couple the primary AC device to the set of AC terminals of the bi-directional power converter when the secondary AC device is uncoupled from the set of AC terminals of the bi-directional power converter.

6. The power system of claim 1 wherein the first switch is a multi-positional relay operable to uncouple the primary AC device from the set of AC terminals of the bi-directional power converter when the secondary AC device is coupled to the set of AC terminals of the bi-directional power converter and to couple the primary AC device to the set of AC terminals of the bi-directional power converter when the secondary AC device is uncoupled from the set of AC terminals of the bi-directional power converter.

7. The power system of claim 1 wherein the first switch comprises at least a first switch element and a second switch element, the first switch element operable to couple and uncouple a first pole of the secondary AC device from a first pole of the set of AC terminals and the second switch element operable to couple and uncouple a second pole of the secondary AC device to a second pole of the set of AC terminals.

8. The power system of claim 1 wherein the first switch is further operable to the operate the primary AC device at low power level when the secondary AC device is coupled to the set of AC terminals of the bi-directional power converter.

9. The power system of claim 1 wherein the first switch is further operable to cause a physical load driven by the primary AC device to be uncoupled from the primary AC device when the secondary AC device is electrically coupled to the set of AC terminals of the bi-directional power converter and to cause the physical load driven by the primary AC device to be coupled to the primary AC device when the secondary AC device is electrically uncoupled to the set of AC terminals of the bi-directional power converter.

10. The power system of claim 1 wherein each of the bridge legs comprises a number of integrated bipolar junction transistors and a number of free-wheeling diodes electrically coupled across respective ones of the integrated bipolar junction transistors.

11. The power system of claim 1 wherein each of the bridge legs comprises a number of metal-oxide semiconductor field effect transistors and a number of free-wheeling diodes electrically coupled across respective ones of the metal-oxide semiconductor field effect transistors.

12. The power system of claim 1, further comprising:

at least one of the primary AC device; and the secondary AC device.

13. An integrated power module, comprising:

a bi-directional power converter comprising a first set of terminals and a second set of terminals, the bi-directional power converter selectively operable to invert a current when the current is flowing from the second set of terminals to the first set of

terminals and to rectify the current when the current is flowing from the first set of terminals to the second set of terminals; and

a first switch operable to selectively electrically couple and uncouple a first device respectively to and from the first set of terminals of the bi-directional power converter.

14. The integrated power module of claim 13 wherein the first switch is further operable to selectively electrically uncouple a second device to the first set of terminals of the bi-directional power converter when the first device is coupled to the first set of terminals and to couple the first device to the first set of terminals when the second device is uncoupled from the first set of terminals.

15. The integrated power module of claim 13 wherein the first switch is further operable to selectively operate a second device at a first frequency when the first device is coupled to the first set of terminals of the bi-directional power converter and to operate the second device at a second frequency when the first device is uncoupled from the first set of terminals wherein the first frequency is less than the second frequency.

16. The integrated power module of claim 13, further comprising:

a second switch operable to selectively electrically reverse a polarity of a coupling of the second set of terminals of the bi-directional power converter.

17. The integrated power module of claim 16, further comprising:

a capacitor;

an inductor;

a diode, wherein the capacitor, the inductor and the diode are electrically coupled to form a boosting circuit with at least one switch of the bi-directional power converter; and

a second switch operable to selectively electrically couple the boosting circuit between the second set of terminals of the bi-directional power converter.

18. An integrated power module, comprising:

a bi-directional power converter comprising a first set of terminals and a second set of terminals, the bi-directional power converter selectively operable to invert a current when the current is flowing from the second set of terminals to the first set of terminals and to rectify the current when the current is flowing from the first set of terminals to the second set of terminals; and

a first multi-positional switch operable to:

in a first position, selectively electrically couple a first device to the first set of terminals of the bi-directional power converter and to selectively electrically uncouple a second device from the first set of terminals of the bi-directional power converter; and

in a second position, selectively electrically uncouple the first device from the first set of terminals of the bi-directional power converter and to selectively electrically couple the second device to the first set of terminals of the bi-directional power converter.

19. The integrated power module of claim 18, further comprising:

a second switch operable to selectively electrically reverse a polarity of a coupling of a third device to the second set of terminals of the bi-directional power converter.

20. The integrated power module of claim 19, further comprising:

a capacitor;

an inductor electrically coupled in series to the capacitor;

a diode electrically coupled to a node between the capacitor and the inductor, the capacitor, the inductor and the diode forming a boosting circuit with at least one switch of the bi-directional power converter; and

a second switch operable to selectively electrically couple the boosting circuit between the second set of terminals of the bi-directional power converter and a third device electrically coupled to the bi-directional power converter.

21. An integrated power module, comprising:

a bi-directional power converter comprising a first set of terminals and a second set of terminals, the bi-directional power converter selectively operable to invert a current when the current is flowing from the second set of terminals to the first set of terminals and to rectify the current when the current is flowing from the first set of terminals to the second set of terminals;

a capacitor, an inductor and a diode electrically coupled with at least one switch of the bi-directional power converter as a boosting circuit; and

a first multi-positional switch operable to:

in a first position, electrically couple the boosting circuit to the second set of terminals of the bi-directional power converter, and

in a second position, electrically uncouple the boosting circuit from the second set of terminals of the bi-directional power converter.

22. The integrated power module of claim 21 wherein the first multi-positional switch is further operable to reverse a polarity of a coupling of the second set of terminals to at least a first DC device through the boosting circuit.

23. The integrated power module of claim 21 wherein the first multi-positional switch electrically couples the boosting circuit to the second set of terminals of the bi-directional power converter when current is flowing from the first set of terminals to the second set of terminals and electrically uncouples the boosting circuit

from the second set of terminals of the bi-directional power converter when current is flowing from the second set of terminals to the first set of terminals.

24. A method of operating a power system, the power system comprising a first switch and a bi-directional power converter, the bi-directional power converter comprising a set of AC terminals, a set of DC terminals and a number of switching components electrically couplable between the set of AC terminals and the set of DC terminals, the method comprising:

operating the first switch to at least one of: electrically couple a secondary AC device to the set of AC terminals of the bi-directional power converter and electrically uncouple the secondary AC device from the set of AC terminals of the bi-directional power converter; and

operating the bi-directional power converter to at least one of: rectify a current when the current is flowing from the set of AC terminals to the set of DC terminals bi-directional power converter and invert the current when the current is flowing from the set of DC terminals to the set of AC terminals of the bi-directional power converter.

25. The method of claim 24 wherein operating the first switch to electrically couple the secondary AC device to the set of AC terminals of the bi-directional power converter further electrically uncouples a primary AC device from the first set of AC terminals of the bi-directional power converter.

26. The method of claim 24 wherein operating the first switch to electrically uncouple the secondary AC device from the set of AC terminals of the bi-directional power converter further electrically couples a primary AC device to the first set of AC terminals of the bi-directional power converter.

27. The method of claim 24 wherein operating the first switch to electrically uncouple the secondary AC device from the set of AC terminals of the bi-directional power converter further causes a physical load driven by a primary AC device to be uncoupled from the primary AC device when the secondary AC device is electrically coupled to the set of AC terminals of the bi-directional power converter and causes the physical load driven by the primary AC device to be coupled to the primary AC device when the secondary AC device is electrically uncoupled to the set of AC terminals of the bi-directional power converter.

28. The method of claim 24 wherein the power system further comprises a second switch, the method further comprising:

operating the second switch to selectively electrically reverse a polarity of a coupling of a DC device to the set of DC terminals.

29. The method of claim 24 wherein the power system further comprises a boosting circuit and a second switch, the method further comprising:

operating the second switch to selectively electrically couple and uncouple the boosting circuit between the set of DC terminals of the bi-directional power converter and a DC device coupled to the set of DC terminals.

30. The method of claim 24 wherein the power system further comprises a second switch, the method further comprising:

operating the second switch to selectively electrically couple a DC device to the set of DC terminals of the bi-directional power converter.

31. The method of claim 24 wherein the power system further comprises a second switch, the method further comprising:

operating the second switch to selectively electrically couple one of at least two DC devices to the set of DC terminals of the bi-directional power converter.

32. The method of claim 24 further comprising:

applying a set of control signals to at least some of the switching components to operate the bi-directional power converter in a boost mode.

33. The method of claim 24 further comprising:

applying a set of control signals to at least some of the switching components to operate the bi-directional power converter in a buck-boost mode.

34. A method of operating a power system, the power system comprising a bi-directional power converter, the method comprising:

electrically coupling a first AC device to the bi-directional power converter;

rectifying a charging AC current supplied by the first AC device to the bi-directional power converter to produce a charging DC current;

charging a DC device electrically coupled to the bi-directional power converter using the charging DC current;

electrically uncoupling the first AC device from the bi-directional power converter;

inverting a discharging DC current supplied by the DC device to the bi-directional power converter to produce a discharging AC current; and

supplying the discharging AC current to a second AC device.

35. The method of claim 34 wherein rectifying a charging AC current supplied by the first AC device to the bi-directional power converter to produce a charging DC current comprises rectifying at least one of a single phase and a three phase current supplied from an electrical power grid.

36. The method of claim 34 wherein rectifying a charging AC current supplied by the first AC device to the bi-directional power converter to produce a

charging DC current comprises rectifying at least one of a single phase and a three phase current supplied from an electric traction motor operating in a regeneration mode.

37. The method of claim 34 wherein supplying the discharging AC current to a second AC device comprises supplying the discharging AC current to an electrical motor.

38. The method of claim 34 wherein supplying the discharging AC current to a second AC device comprises supplying the discharging AC current to an electrical power grid.

39. The method of claim 34 wherein inverting a discharging DC current supplied by the DC device to the bi-directional power converter to produce a discharging AC current comprises inverting a current received from an electrical storage device.

40. The method of claim 34 wherein inverting a discharging DC current supplied by the DC device to the bi-directional power converter to produce a discharging AC current comprises inverting a current received from a fuel cell system.

41. The method of claim 34, further comprising:

electrically uncoupling the second AC device from the bi-directional power converter when electrically coupling the first AC device to the bi-directional power converter.

42. The method of claim 34, further comprising:

physically uncoupling a load driven by the second AC device from the second AC device when electrically coupling the first AC device to the bi-directional power converter.

43. The method of claim 34, further comprising:

reducing an amount of power required from the bi-directional power converter by the second AC device when electrically coupling the first AC device to the bi-directional power converter.

44. The method of claim 34, further comprising:

selectively electrically coupling a boosting circuit between the bi-directional power converter and the DC device.

45. The method of claim 34, further comprising:

electrically coupling a boosting circuit between the bi-directional power converter and the DC device when the charging DC current is being supplied to the DC device and electrically uncoupling the boosting circuit from between the bi-directional power converter and the DC device when the discharging DC current is being supplied by the DC device.

46. The method of claim 45, further comprising:

electrically reversing a polarity of the electrical coupling between the bi-directional power converter and the DC device when electrically coupling and uncoupling the boosting circuit.